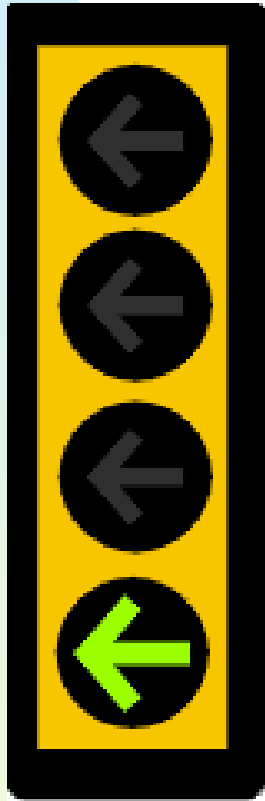


Traffic Signal Technician / Contractors Conference
April 10 through April 11, 2007
Raleigh, NC

Four-Section Protected- Permissive Flashing Yellow Arrow Traffic Signal Head

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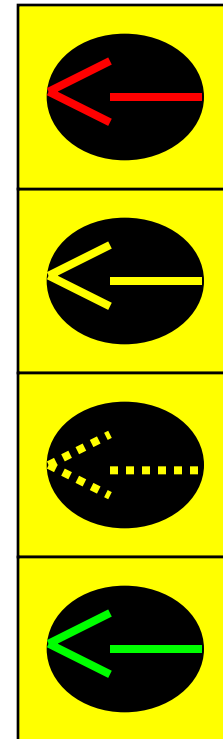
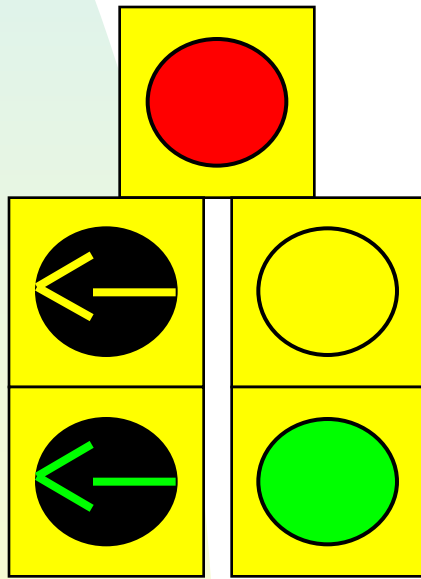


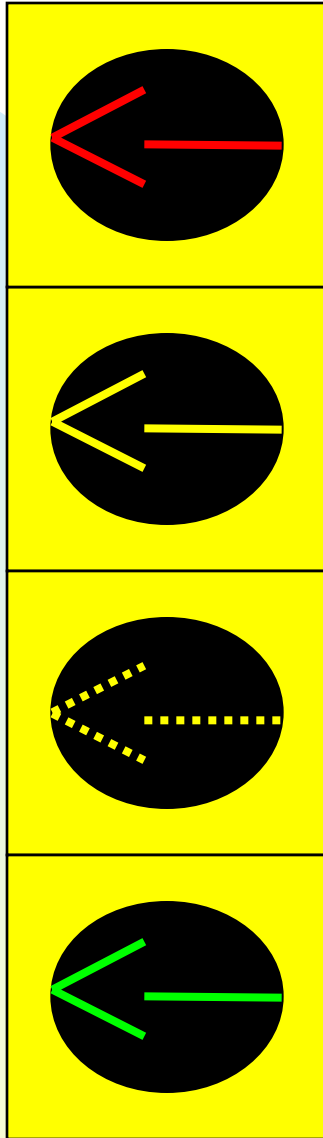
Introduction

- What is the “four-section protected-permissive flashing yellow arrow traffic signal head?”
- The national experience.
- The North Carolina experience.
- Where are we going?

“What is the four-section protected-permissive flashing yellow arrow traffic signal head?”

- It is a potential alternative to the 5-section “doghouse” or cluster traffic signal head currently used in North Carolina.





Solid Red Arrow – Stop. No turns are allowed.

Solid Yellow Arrow – Prepare to stop. Clearance for both, green arrow and flashing yellow arrow.

Flashing Yellow Arrow – Left turns are allowed, but first they must yield to oncoming traffic and pedestrians.

Solid Green Arrow – Left turns allowed, and they do not need to yield to oncoming traffic and pedestrians. Proceed with caution.

Advantages

- Research indicates it is the most intuitively understood display for motorists.
- Eliminates the “Yellow-Trap” by tying the flashing yellow arrow to the opposing green ball.
- Versatility - Can be used for different phasing schemes.
- Promotes nationwide consistency for protected-permitted displays.

National Study of Four-Section Protected-Permissive Flashing Yellow Arrow Traffic Signal Head

- Transportation Research Board study sponsored by AASHTO in cooperation with FHWA
- 228 individual locations nationwide were approved for implementation.
- Insufficient crash data was provided to FHWA to draw conclusions.
- What drivers say they will do and what they actually do in the driving environment is not always consistent!
- Field data / observations supported a higher understanding of the flashing yellow arrow display.

National Study (Continued)

- Drivers are confused by circular green indication and often assume it provides right-of-way during permissive left-turn intervals.
- Drivers interpret the flashing yellow arrow display correctly.
- Five-section cluster demonstrated significantly more fail-critical responses compared with a flashing yellow arrow.
- Flashing yellow arrow demonstrated a higher fail-safe response compared with a circular green.

National Study (Continued)

- Flashing yellow arrow was successfully implemented in the field with very few technical or political issues.
- Flashing yellow arrow is the only display that provides a universal solution for different intersections.

Traffic Engineers' Perspective

On the national level, traffic engineers favor the new display.

- Provides an exclusive signal display for left turn control.
- Indications are flashing, which attracts more attention.
- Indications provide enhanced operational control.

National Public Opinion

Comments from the public have generally been positive.

- “I like the flashing yellow arrows much better than the “combo” signals.”
- “I witnessed an accident...and one comment from the man at fault was that he had the solid green circle.”
- “I have noticed my own reaction. When I see a green light...my trained response is to “go.””
- “This amber arrow clearly said to us the first time we encountered one-”you may make a turn with caution.””

NCDOT Experience

Implemented Locations

(9 Signalized Locations)

- NC 132 (College Rd) at K-Mart/Outlet Mall in Wilmington, New Hanover County (SIN 03-0212) - Implemented November 2005
- NC 132 (S. College Rd) at Holly Tree Rd in Wilmington, New Hanover County (SIN 03-0362) - Implemented January 2007
- SR 2911 (New Bern Ave) at Visitor's Entrance to WakeMed in Raleigh, Wake County (SIN 05-0905) - Implemented February 2005
- NC 87 at SR 1115 (Buffalo Lakes Road) in Spout Springs, Harnett County (SIN 06-0716) - Implemented February 2006

NCDOT Experience (continued)

- NC 5 at SR 1205 (Morganton Rd) / Golf Terrance Entrance in Pinehurst, Moore County (SIN 08-0346) - Implemented October 2006
- Four Locations along US 401 Business (Raeford Rd) in Fayetteville, Cumberland County - Implemented November 2007:
 - Fairfield Street (SIN 06-0001)
 - Purdue Street (SIN 06-0224)
 - Brighton Road (SIN 06-0328)
 - Montclair Road (SIN 06-0334)

NCDOT Experience Planned for Implementation

(7 Signalized Locations)

- US 158 (Croatan Hwy) at SR 1206 (Kitty Hawk Rd) in Kitty Hawk, Dare County (SIN 01-0260)
- US 258 at SR 1001 (Paul's Path Rd) / SR 1557 (Hull Rd) in Kinston, Lenoir County (SIN 02-0451)
- NC 24 at SR 1141/1144 (Hibbs Road Extension) in Morehead City, Carteret County (SIN 02-0470)
- NC 55 / SR 1402 (Broad St) at NC 55 (Ennis St) in Fuquay-Varina, Wake County (SIN 05-2252)
- SR 2298 (Russell St) at SR 2311 (Gillespie St) in Fayetteville, Cumberland County (SIN 06-0014)
- US 64 at NC 751 / SR 1001 in New Hill, Chatham County (SIN 08-0419)
- NC 107 at SR 1330 (N Country Club Rd / Forest Hills Rd) in Cullowhee, Jackson County (SIN 14-0908)

NCDOT Experience

Planned for Implementation

(3 Corridors)

- Division 2 - NC 58 (Emerald Drive) from Coast Guard Road to Bogue Inlet Drive in Emerald Isle, Carteret County (4 Signals)
- Division 6 - US 401 (Ramsey Street) from Stacy Weaver Road / Methodist College to Northgate Shopping Center / Wendy's in Fayetteville, Cumberland County (6 Signals)
- Division 12 - SR 2200 (Cox Road) from I-85 SB Ramp to Gaston Mall Entrance in Gastonia, Gaston County (3 Signals)

05-0905

**SR 2911
(New Bern Ave)
at
Visitor's
Entrance to
WakeMED
(Raleigh, Wake
County)**



SR 2911 (New Bern Ave) at Visitor's Entrance to WakeMED in Raleigh, Wake County.

Crash Statistics

- Target Crashes - Left Turn, Same Roadway and U-Turn Crashes
- Before Crash Reports - February 1, 2002 through January 31, 2005 (3 Years Before)
- After Crash Reports - March 31, 2005 through February 28, 2006 (1 Year After)
- Before Crashes - 28 in 3 years (9.3 per year)
- After Crashes - 5 in 1 year
- **Reduction - 46.4%**

03-0212

**NC 132
(College Rd) at
K-Mart / Outlet
Mall
(Wilmington,
New Hanover
County)**



NC 132 (College Rd) at K-Mart / Outlet Mall in Wilmington, New Hanover County.

Crash Statistics

- Target Crashes - Left Turn, Same Roadway and U-Turn Crashes
- Before Crash Reports - November 1, 2002 through October 31, 2005 (3 Years Before)
- After Crash Reports - December 1, 2005 through November 30, 2006 (1 Year After)
- Before Crashes - 26 in 3 years (8.7 per year)
- After Crashes - 4 in 1 year
- **Reduction - 53.8%**



06-0716

**NC 87 at SR 1115
(Buffalo Lake
Rd)**



**(Spout Springs,
Harnett County)**

06-0224

**US 401
Business
(Raeford Road)
at
Purdue Street
(Fayetteville,
Cumberland
County)**



08-0346

**NC 5 at SR
1205
(Morganton
Rd) / Golf
Terrance
Entrance

(Pinehurst,
Moore County)**



NCDOT Traffic Engineers' Perspective

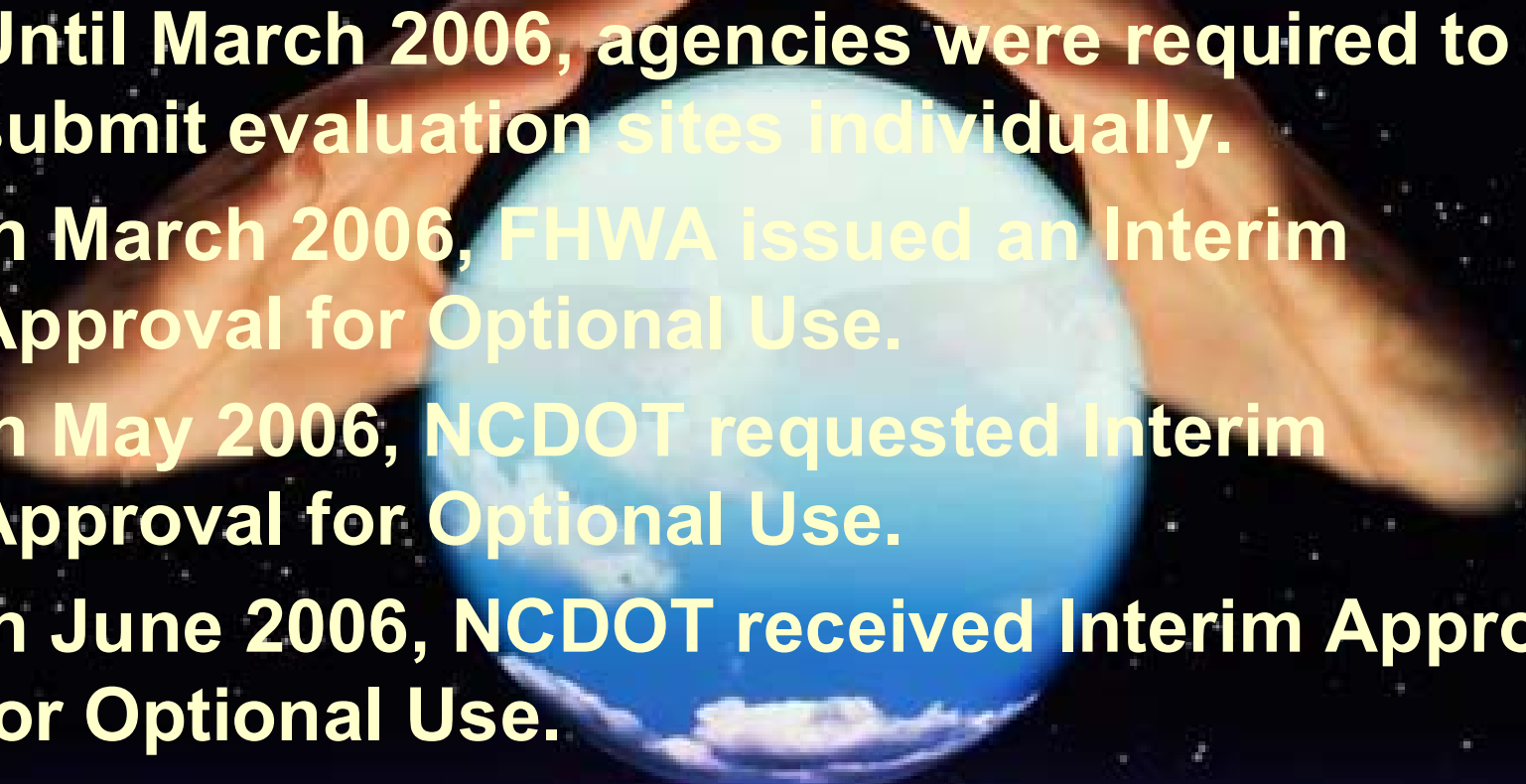
- **Initial Opinions Were Skeptical- “You are going to get someone killed.”**
- **Proof has been “in the pudding.” Site visits by field and office personnel to the New Bern Avenue at WakeMED location have convinced almost all engineers.**
- **Final Opinions Are In Support - “Motorists’ actually appear to understand what it means.”**

North Carolina Public Comment

Comments in NC have mirrored the nation.

- “Years ago, I was riding with a friend, who had her license for a few months at that time. Then one day, we almost crashed...I expected her to come to a slow stop and yield to oncoming traffic. Instead, she didn't look at the traffic, only to glance at the solid green light that stood before us.”
- “I think the flashing yellow arrows that indicate left turns are permitted while yielding is a fantastic idea... The modification will help tremendously with preventing accidents and hopefully saving lives.”
- “I'm a nurse at WakeMed and I LOVE the new light!!”

Where Are We Going?

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- Until March 2006, agencies were required to submit evaluation sites individually.
 - In March 2006, FHWA issued an Interim Approval for Optional Use.
 - In May 2006, NCDOT requested Interim Approval for Optional Use.
 - In June 2006, NCDOT received Interim Approval for Optional Use.
 - 2009 MUTCD ?

- Device is NOT yet an MUTCD approved display.
- Department MUST maintain an inventory of all locations.
- Sites MUST be restored to a condition that complies with the MUTCD within 3 months of Final Ruling.
- Use MUST be terminated any time significant safety concerns are attributed to the device or its application.

WHAT IS
THE
CATCH?

Where Are We Going?



- As of March 15, 2007, 28 jurisdictions have Interim Approval from FHWA.
- States Agencies include: Wyoming, Washington*, Missouri, Oregon*, Colorado, Michigan, and North Carolina.
- Numerous other city and county jurisdictions throughout the nation including Fayetteville, NC.

*(Includes local jurisdictions.)

Where Are We Going?

- Primary display will remain the 5-section “doghouse” / cluster during the interim approval period.
- Use of four-section, protected-permissive, flashing yellow arrow will generally be limited to existing protected-permissive locations during the interim approval period.
- Locations should have either identified “correctable” crash patterns or be locations where “more restrictive” signal phasing would provide hardship.
- If included in the updated MUTCD, it may become the primary p/p display (TBD).
- No funding for replacements; cluster heads will still be acceptable.



Have a Location for Consideration?

- **Submit a request to the Regional Traffic Engineer's office.**
- **Regional Traffic Engineer will coordinate with the Signals & Geometrics Engineer to evaluate.**
- **Recommendations will be needed by:**
Division Traffic Engineer
Regional Traffic Engineer
- **Approval by:**
Signals & Geometrics Engineer
State ITS and Signals Engineer
Municipality Representative (where applicable).
- **Traffic signal plans will need to be prepared.**



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